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Governor

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MEMORANDUM
January 30, 1985

To: Kyle Cook

From: Joe Joy

Subject: Pacific Beach Survey Report

Abstract

A late-fall receiving water study of Stream #0744 and Joe Creek (segment 10-21-19) below the Pacific Beach wastewater treatment system (WTS) was performed. Receiving water and WTS effluent discharge measurements were made and effluent residual chlorine was also measured. The results indicated little chance of chlorine reaching Joe Creek at levels harmful to salmonids and other aquatic life. However, other possible water quality problems in the pond on Stream #0744 below the WTS outfall and in Joe Creek may be present during low-flow conditions. An additional late-summer, low-flow, follow-up survey was recommended.

Introduction

As you know, Bill Chamberlain and I made our initial field survey of the Pacific Beach WTS and its receiving water on November 7 and 8, 1984. We focused on effluent and receiving water discharge measurements, and physical measurements of the pond located between the WTS outfall and Joe Creek. I have briefly discussed some of our findings with you, but I wish to expand upon them in this report so you can better decide the direction of any future work at Pacific Beach.

Site Description

The Pacific Beach WTS has nearly completed a major upgrade. When completed, the upgrade will include:

- Improvements in the wastewater collection system
- Renovation of the two-cell waste treatment lagoon and the chlorine contact chamber

- Installation of flow-paced chlorination/dechlorination equipment
- Construction of an operations/laboratory building

These improvements should result in new design criteria as stated by Parametrix (1984) (Table 1).

The Pacific Beach WTS outfall discharges to Stream #0744 (Phinney and Bucknell, 1975), a small tributary of Joe Creek (Figure 1). Stream #0744 has a total Approximate length of 1.2 miles. The upper half is shown on USGS maps as being intermittent. The Pacific Beach WTS outfall enters Stream #0744 at river mile (r.m.) 0.2, just above a large pond. The pond's outlet leads to a straight and narrow clay channel, over a three-foot cascade, and into Joe Creek.

Joe Creek watershed drains approximately 24 mi^2 of low-lying forest before entering the ocean just south of Pacific Beach (Bucknell and Ames, 1981). Approximately 18.5 mi^2 of the watershed, including Stream #0744, are located above r.m. 1.1, just below the confluence of Joe Creek and Stream #0744 (Bucknell and Ames, 1981).

There are no discharge data for the Joe Creek watershed. However, Phinney and Bucknell (1975) make the following general comments which indicate something of the flow conditions there:

> "[Joe Creek] has an average width of 8 yards during the winter months and 6 yards during the summer months in its lower reaches."
>
> and,
>
> "During the low stream flow period the mouths of most of these ocean tributaries may be blocked by a buildup of beach sand. These sand bar buildups are broached by high winter flows."

Joe Creek and its tributaries are not specifically classifed in WAC 173-201-080. Therefore, they hold Class A water quality classifications according to WAC 173-201-070(6). No water quality data are available for the Joe Creek system.

Methods

We measured and calculated discharge at the following three receiving water sites using a magnetic flow meter, top-set staff, and tape measure (Figure 1):

- Site 1: Stream #0744 thirty feet below outfall
- Site 2: Stream #0744 below pond and fifteen feet above Joe Creek
- Site 3: Joe Creek twenty feet below confluence with Stream #0744

Table 1. Pacific Beach wastewater treatment plant design criteria (from Parametrix, Inc. [1984]).

PACIFIC BEACH WASTEWATER TREATMENT

PLANT DESIGN CRITERIA

Design Loading	Year 1984	Year 2003
- Flow (gpd)		
Avg. Day Dry Weather (ADDW)	52,000	57,000
Avg. Day Wet Weather	55,000	59,000
Peak Wet Weather (PWW)	206,000	222,000
- BOD (lb/day)		
Avg. Day Dry Weather	95	104
Avg. Day Wet Weather	85	93
- Suspended Solids (lb/day)		
Avg. Day Dry Weather	95	104
Avg. Day Wet Weather	85	93
Unit Processes		
- Lagoon		
Type	Facultative	
Number of Cells	2	2
Water Depth	4 ft.	4 ft.
Total Detention Time (days)		
Summer	85	77
Winter	80	75
Total Water Surface Area (acres)	3.4	3.4
Overall BOD Removal Efficiency	80%	80%
Lagoon Cell #1		
Volume (1,000 gallons)	3,100	3,100
Water Surface Area (acres)	2.4	2.4
Detention Time (days)		
Summer	60	54
Winter	56	53
Lagoon Cell #2		
Volume (1,000 gallons)	1,300	1,300
Water Surface Area (acres)	1	1
Detention Time (days)		
Summer	25	23
Winter	24	22

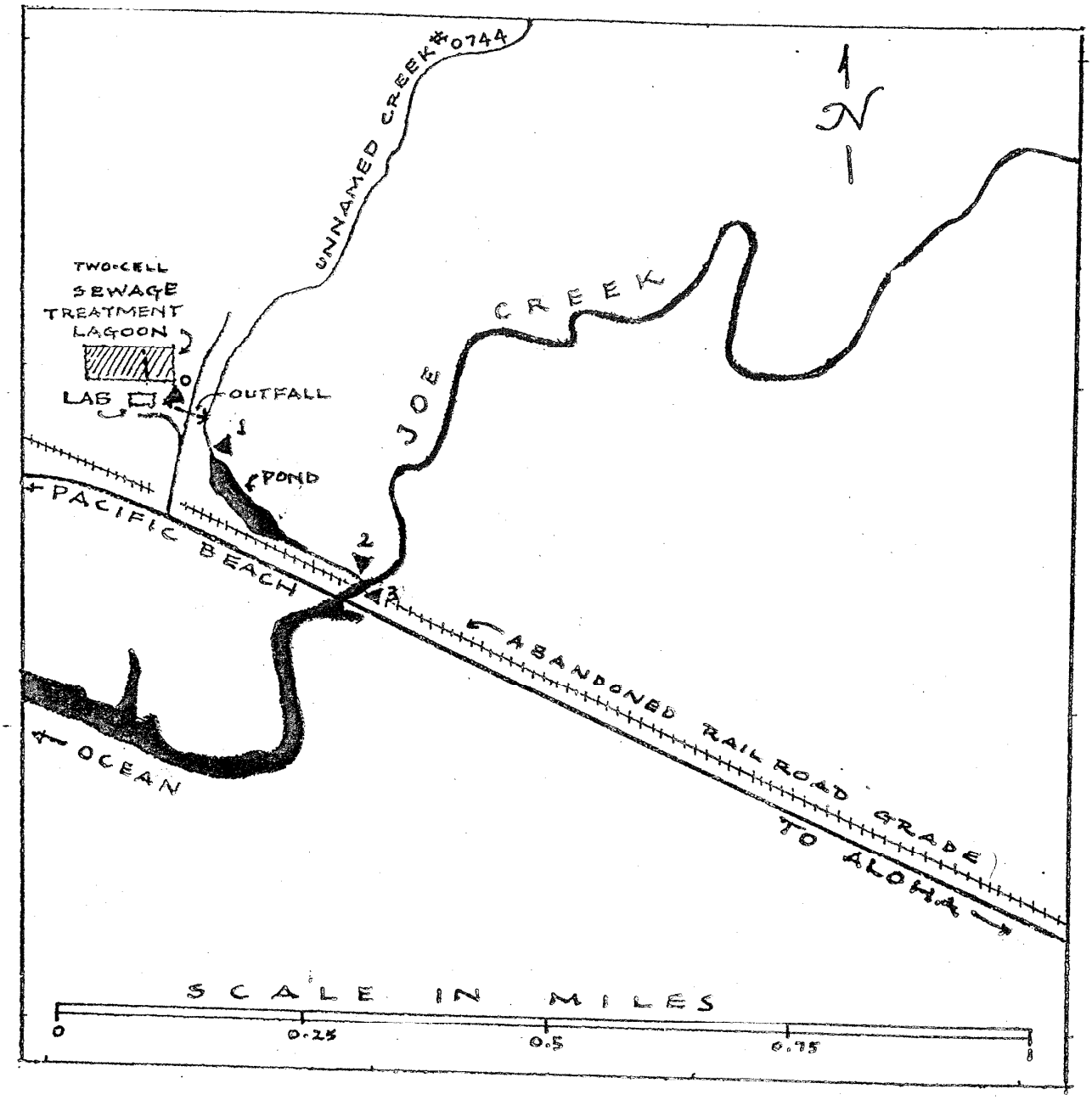


Figure 1. Pacific Beach sewage treatment lagoon and receiving waters. Discharge measuring stations (▲) are indicated.

In addition, effluent discharge from the Pacific Beach WTS was obtained at both ends of the chlorine contact chamber by measuring head heights behind the existing 22.5° V-notch weir, and four-feet-long, sharp-crested, rectangular weir. No discharge measurements were made on Stream #0744 above the outfall. Wood debris clogs that portion of the stream.

Using the magnetic flow meter, top-set staff, and tape measure, we also measured the discharge of the Moclips River at Moclips. We did this for two reasons: (1) daily discharge data are available for the Moclips River from USGS records (Station 12039220) for 1975 - 1981; and (2) the Joe Creek and Moclips River watersheds seem very similar in size, topography, and land use.

Besides making discharge measurements, we used a weighted tape and small boat to obtain depth and surface measurements of the pond below the outfall. We made four transects across the width of the pond, measuring depth approximately every fifteen feet. We measured surface distance between an additional five sets of points. Later, these measurements were used to calculate the pond's surface area and volume using a planimeter, and the sum of frustrum volumes method (Lind, 1979), respectively.

Also, we measured chlorine residual in the effluent once at the head end of the chlorine contact chamber and three times at the outfall end using the DPD-ferrous titrametric method (U.S. EPA, 1979).

Results and Discussion

Hydrologic Features

Results of the discharge and chlorine residual measurements are shown in Table 2. Also included are theoretical dilution ratios of:

- Pacific Beach WTS effluent Stream #0744
- Joe Creek to Stream #0744
- Joe Creek to Pacific Beach WTS effluent

The pond located between the outfall and Joe Creek is evidently naturally formed, and not a beaver pond; a clay stratum and piles of wood debris form a plug at its outlet. The bathymetric and associated hydrographic data obtained from the survey measurements are shown in Figure 2. The pond volume is nearly equal to the 1.3 million-gallon second cell of the Pacific Beach treatment lagoon (Table 1). The calculated simple retention time of twenty hours is probably too fast because submerged wood debris and aquatic plants probably create dead spots and hamper complete circulation.

The pond level and volume probably fluctuate widely within a season as well as between seasons. According to local residents, the area had experienced three heavy rainstorms during the week prior to our survey. This may be the reason we observed a fresh high-water mark of duckweed 2 1/2 feet higher than the pond's surface. The debris at the outlet probably greatly slows the release of water out of the pond at these times.

Table 2. Discharges and residual chlorine concentrations and dilution ratios calculated from field work at Pacific Beach treatment system and vicinity on November 7-8, 1984. Station numbers coincide with those in Figure 1.

Station Number	Description	Discharge (cfs)	Chlorine Residual (mg/L)	Dilution Ratio
0	Effluent	0.04-0.09	0.2	#0744:effluent 25.5:1-50:1
1	Stream #0744 above pond	2.0, 2.4	0.004-0.008*	Joe Cr.:effluent 1300-3250:1
2	Stream #0744 below pond	2.0, 2.7	--	Joe Cr.:#0744 65:1
3	Joe Creek below confluence of Stream #0744	130	--	
	Moclips River at Moclips	300	--	

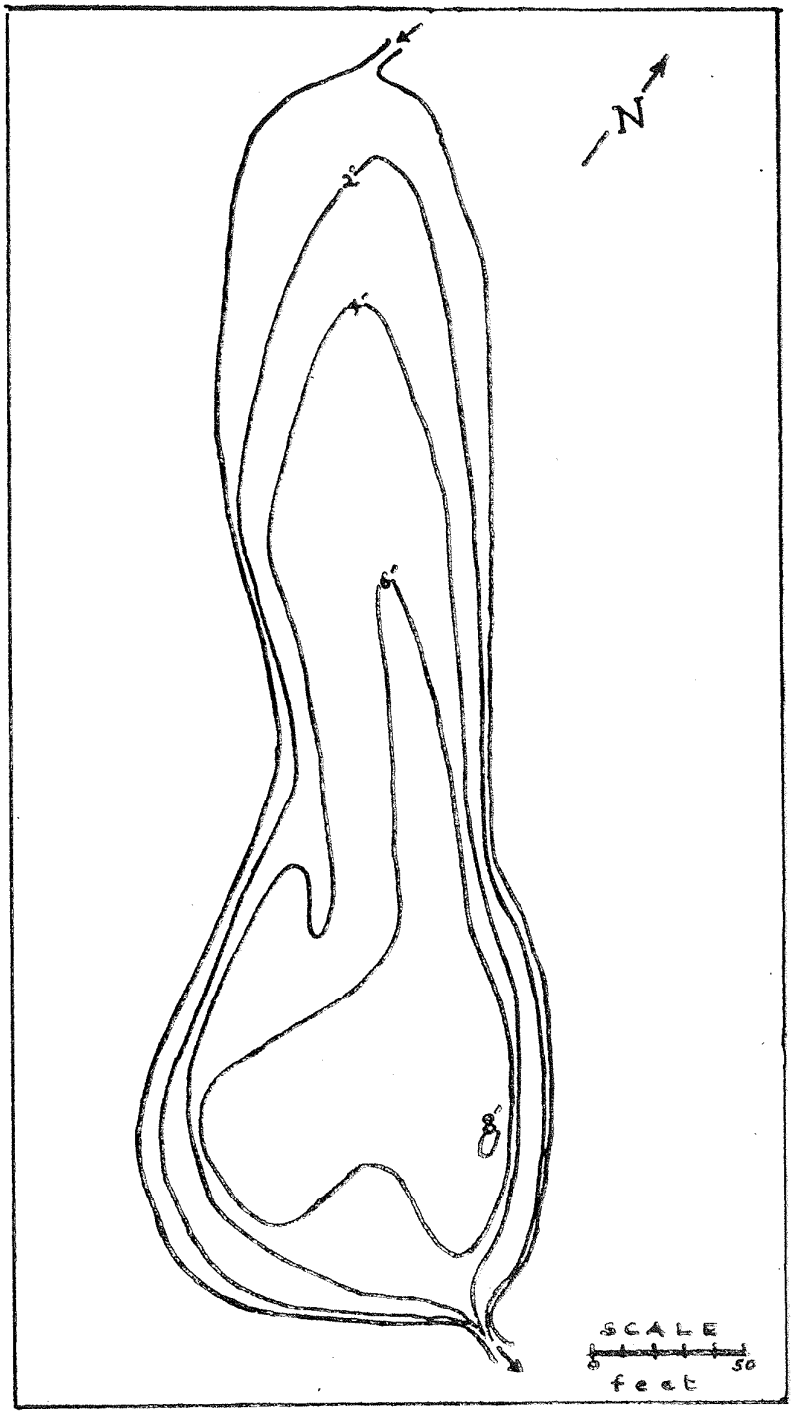
*Estimated concentration based on dilution of effluent chlorine residual in Stream #0744.

As mentioned earlier, the pond's outlet stream follows a straight, narrow, clay channel before spilling down a three-foot cascade into Joe Creek. These formations in combination with the wood debris plug may pose an impassible barrier to anadromous fish. However, Phinney and Bucknell (1975) do not show a barrier on their map.

We observed the level of Joe Creek at the confluence of Stream #0744 fluctuate approximately 1/2 to 1 foot between the 8.9-foot high tide and 0.5-foot low tide on the 7th of November. The mean high tide calculated from NOAA (1976) data is 7.8 feet. However, during high tide we measured the average water velocity in Joe Creek at greater than 1 cfs, and we observed no flow reversals at this location.

Chlorine Toxicity

The chlorine concentration at the head end of the chlorine contact chamber was 2.0 mg/L. At the outfall end, it was 0.2 mg/L at each of the three samplings. Chlorine values based on effluent chlorine concentrations and dilution by receiving water volumes are presented in Table 2. Although the stream-to-effluent dilution ratio was as low as 26:1, the theoretical chlorine concentrations in the receiving water during the survey met the general EPA aquatic life criterion of 0.01 mg/L (USEPA, 1976), and proposed 30-day average criterion of 0.0083 mg/L (FR, 1984) at Station 1 (Figure 1). However, the current 0.002 mg/L EPA chlorine criterion to protect salmonids was not met. The actual concentration of chlorine could not be measured since the DPD-Ferrous titrimetric method is only accurate in river water to 0.01 mg/L (USEPA, 1979).



POND DATA

Volume	= 160,000 ft^3 or 1.2 million gal.
Surface Area	= 38,600 ft^2
Mean Depth	= 4.1 ft.
Maximum Depth	= 8 ft.
Maximum Length	= 420 ft.
Maximum Width	= 120 ft.
Retention Time at 2.2 cfs Inflow and Outflow	= 0.84 day or 20 hrs.

Figure 2. Bathymetric contour map of pond on Stream #0744 below the Pacific Beach treatment plant. Data collected November 7-8, 1984.

Chlorine residual was not expected to reach Joe Creek. The 20-plus-hour travel time and the verdant growth of aquatic weeds in the pond make survival of a chlorine residual unlikely.

Summer Low-Flow Evaluation

A general idea of summer low-flow conditions in Joe Creek may be gained from comparisons with the Moclips River annual flow cycle. This can only be a rough comparison since we have taken only one pair of discharge measurements. Several sets of measurements during diverse hydrologic conditions would be necessary for a complete comparative analysis.

The monthly average and monthly mean minimum flows for the Moclips River are charted from the five years of USGS data at station 12039220 (USGS, 1975-81) (Figure 3). In addition, the data indicate the seven-day low flow for the five years record period was 4.3 cfs. Also shown in Figure 3 are the discharge measurements of the Moclips River and Joe Creek taken during our survey.

Based on the Moclips River data, I would expect summer low flows on Joe Creek to be at least as low as the Moclips River; i.e., an average minimum of 10 cfs and an extreme minimum of 4.3 cfs. These estimated flows could then be used for formulate some worst-case scenarios.

One possible worst-case low-flow condition could have the following elements:

- No upstream flow in Stream #0744
- Pacific Beach WTS effluent discharge at summer average: 0.08 cfs (Parametrix, 1984)
- No pond below the outfall on Stream #0744
- Minimum flow in Joe Creek: 4.3 cfs

The dilution ratio of Pacific Beach WTS effluent directly into Joe Creek under these extreme conditions would be 1:54. If the effluent contained 0.2 mg/L residual chlorine, the concentration in Joe Creek after total mix would be 0.004 mg/L. This concentration meets all EPA criteria except for the protection of salmonids.

In another case, we could suppose that the conditions would be similar to those above, except we would include the pond's presence. If the current maximum depth of the pond were decreased by half, to four feet, the simple retention time of effluent through the pond during low-flow would be greater than five days. Under these conditions, no chlorine would likely enter Joe Creek. However, the pond's water quality may be seriously impaired.

A final example would suppose that a beach sand barrier were present at the mouth of Joe Creek. Such a barrier could possibly reduce Joe Creek to a stagnant swamp with some water quality problems; e.g., high temperature and low dissolved oxygen. These water quality problems could become more severe from adding effluent to the stagnant creek. Chlorine toxicity would probably be of minor importance compared to lowered dissolved oxygen and higher biochemical oxygen demand.

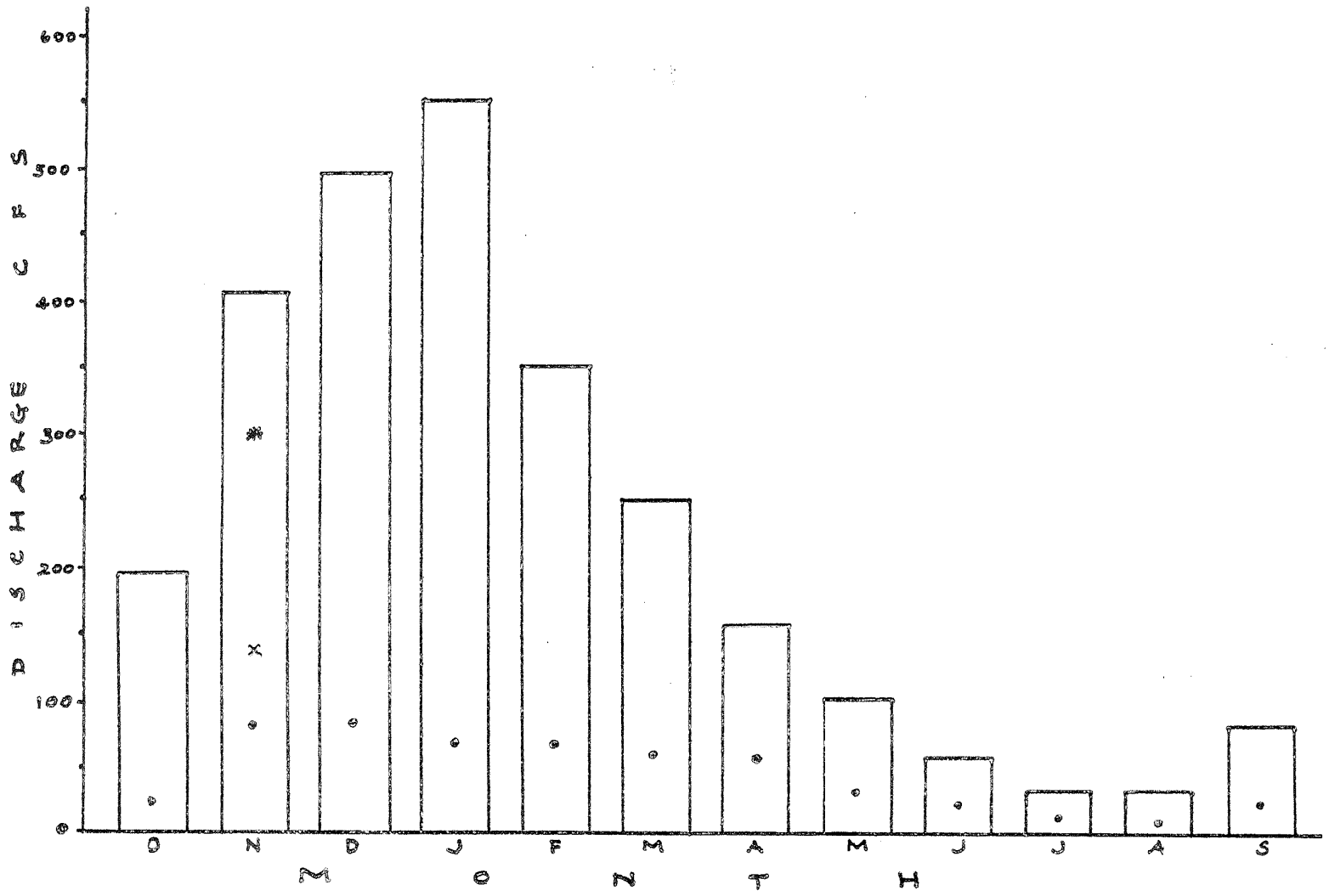


Figure 3. Monthly mean and mean minimum discharge (•) for the Moclips River at Moclips, Station 12039220 (USGS 1975 - 1981), compared to November 7, 1984, discharges taken on Joe Creek below Stream #0744 (x) and on the Moclips River (*).

At the present, we have too little information to know which scenario is most like actual low-flow conditions. These suppositions, based on the available data, suggest possible natural problems on Joe Creek that may be aggravated by the introduction of effluent. Furthermore, the water quality in Stream #0744 below the WTS outfall most likely is impaired during low-flow conditions.

Conclusions

The findings made during the November survey indicate little or no chlorine reached Joe Creek from the Pacific Beach WTS. The configuration of the receiving water system on Stream #0744 may protect Joe Creek from chlorine under most flow conditions. Chlorine toxicity, the only parameter analyzed, did not seem to be a problem in Stream #0744 unless salmonids were present. Presently there is no fishery or general water quality information available for the streams. However, it appears that both Stream #0744 and Joe Creek may experience water quality problems during low-flow periods.

Recommendations

Based on the findings to date and the questions raised concerning low-flow conditions, I would recommend a summer low-flow survey be performed. The second winter survey suggested in the study proposal (Joy, 1984) would not add any substantial information to that which we have already obtained.

JJ:cp

Attachments

cc: Lynn Singleton
Mike Gardner, WDOE Municipal Grants

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